SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Royal School of Mines, Jermyn-Street.

MR. WARINGTON SMYTH'S LECTURES.

[FROM NOTES BY OUR REPORTER.]

LECTURE LVI.—Mr. SMYTH said that the remainder of this somewhat lengthy course of lectures would be devoted to those processes by which the ores were fitted for the market; as by far the greater proportion of the minerals brought to the surface were not in a condition for commercial operations. These processes for the most part were most profitably carried out at the mine; because, first, the removal of the refuse and rubbish associated with the ore was always a costly undertaking. Secondly, because the rate of wages in mining districts was frequently lower than in the manufacturing localities to which the ores eventually went. Thirdly, the miners were, generally speaking, more conversant with the waste and the methods most suitable for the purpose of removing it. Fourthly, they were commonly provided with steam or water power brought to the mine for other purposes, but which might be turned to advantage in working the different kinds of apparatus used in the dressing processes. If they took the case of the metallic minerals they would find that they required a great amount of labour to be expended upon them before the ores were brought out dressed or ready for market; but the non-metallic minerals also required some degree of dressing. For instance, in dealing with slates and building stones enormous quantities of waste had to be left at their respective quarries, which could not be conveyed to any distance, however slight, without a great expenditure. Some of these could be dressed with much greater ease and rapidity when first got, while they were comparatively soft and moist, than after a length of time. At some of the slate quarries in Wales enormous mountains of refuse were to be seen, and vast quantities, probably, of small slate along with it, but which, under the circumstances of the case, it would not pay to remove. The workmen, then, having it let to them by bargains, would, they might be certain, make the most they could. It, therefore, required special knowledge to form right conclusions on these subjects. So with a stone quarry, the only question with regard to some of this waste was whether it could be turned to any profitable use. In some few cases that might be done, but in the vast majority of instances the great masses of refuse to be seen were worthless. He did not think that would always be so, and he could not help thinking that there was a fine opportunity for an inventive genius to make some suggestion on this matter. Thus, when in some districts they were quarrying hard material, a good deal was brought away now for roads and ballast which used to lie as mere valueless rubbish. China-clay, which was worked largely in this country, was associated with other materials, and dressing, therefore, was necessary before it was ready for the market. It was found in Cornwall and Devon in the granitic districts, when the felspar was changed from a solid slate to a powdery condition, and when mixed with water came away with a milky appearance. It was then passed through a series of long troughs of wood, called mica pits, in which the specific gravity of the clay caused it to settle. This was repeated until the water had carried off all the foreign material, and left the china-clay in a fit state for the market, in deposits of from 8 to 10 in. in depth, which were afterwards cut up into blocks. Another non-metallic mineral which required dressing was coal—as, for instance, picking, weighing, and screening. Some of this was done by hand, and in that way pieces of stone, slate, or pyrites were removed; but there were cases in which it might be treated in another manner. First of all must be regarded that which is saleable at the best prices, and it was necessary, therefore, to separate the large from the small by screening. This was done by an arrangement of a simple form. A rectangular screen was set up, inclined at an angle of about 18 inches in the yard, and the coal was then thrown upon it and allowed to run down. The bars were placed from ⅛ to ⅜ths of an inch asunder, and what fell through was, therefore, small dust. A great deal of division was effected by this method, resulting in several sizes of coal, designated "nuts," "peas," "duff," &c. A beautiful model of these implements was in the Museum, the work of Mr. Wales, done to scale. In place of this kind of screen it was proposed some years ago to adopt a circular rotating screen. In some districts there was always mixed with the coal little strips, or scales, or portions of pyrites, and in the French coal field a variety of contrivances were in use to get rid of these impurities—apparatus with which it was to be wished our coal agents and managers were better acquainted. He would next turn to metalliferous ores, and they would see how much trouble, care, and expense were needed in dealing with ores of different classes. The processes used were called "dressing," or as in Germany "aufbereitung." On the Continent many works on this subject had been published, but there were none better than that of Von Rittenger, of Vienna, which was adjudged worthy of the highest medal at the late Paris Exhibition. The question first to be considered was which mineral was the ore mixed up with in the matrix, or, in other words, what was the nature of the impurities it presented. Take an iron ore—peroxide of iron, for instance. It was evident that whether or not there would be any profit depended upon the percentage of metal in the ore; for, besides all the cost of winning, it must be ground down to fragments of small size, and the quartz separated by what was called "jigging," and thus great expense was incurred. It must, therefore, in many have but a small proportion of rubbish. So with lead ores, or even rich galena, they might be overloaded, as it were, with the expense of dressing. It was sometimes questionable, under some circumstances, whether it was advisable to go to any expense in dressing, while some lead ores of an argentiferous character would pay if they got 1 ton of saleable ore to many tons of refuse. In some places it was not uncommon to pound 20 tons, and to pass it through a great variety of processes, to get 1 ton of good lead ore. In tin they had frequently to deal with 100 or 200 tons of material for 1 ton of valuable ore; and when they came to gold and silver the percentage was exceedingly minute—as, for instance, ½ oz. of gold to a ton of material in the St. John del Rey Mine, while in Australia and in the Hartz 4 or 5 ozs. to 50 tons. Passing under view all the processes, he must mention first of all that a good deal of separation from refuse went on underground, and the men should have their bargains set in such a manner that it might be to their interest not to deteriorate valuable ore by mixing it with valueless stones. There was naturally in all metalliferous mines a great deal of mere "attle," or "deads," which ought to be separated and left below. At the surface it was necessary to get a situation where there was a good fall of water, so that the slime pits and washing might be advantageously managed. The lecturer concluded by a lengthened explanation of various models of new washing griddles, used now frequently instead of grates, and of various other apparatus.

LECTURE LVII.—Having placed before them a few of the general considerations which came into play in first noticing the arrangements which were to be made for the dressing or mechanical preparation of minerals—pointing out the necessity of the selection of a suitable spot, and then some of the simplest contrivances when carried out by hand or manual labour, which involved a considerable amount of picking and selection—Mr. SMYTH remarked that these operations had for their object, and especially the washing of the mineral masses as they came from the mine, the getting rid of the clay, or mud, or powder smoke with which they were mingled. The first thing was to see of what these masses were composed, and to determine upon that whether they should be broken up into two, or three, or more different sizes, and so get a division of those pure ores from the dradge or brangled ore, ready for sampling. When the orey material was apt to be mingled with argillaceous matter it must be washed, involving a large amount of machinery, depending as to its kind and character on the nature of the ore, and the amount of money that could be afforded to pay for such processes. Rittenger's machine was one of the best for dealing with material when it was clogged with clay and difficult to wash by the more ordinary processes. It separated the material into four distinct parts, and would pass from 10 to 15 tons in 12 hours. In the eastern part of Hungary, where that beautiful metal tellurium was found in the greystone rocks, and apt to be associated with a tenacious clay, a good deal of machinery was used for the purpose of getting rid of the latter. Of this machinery he exhibited several models. If large masses had to be broken up it was done by what was called "spalling." It was usual to let this work to certain persons at such and such a rate per ton, which was the only way of insuring a fair amount of work for the money paid. This involved a considerable expense, and various contrivances had been used to reduce it. Thus it had been proposed to use tilt hammers, and various simple apparatus of that kind. One of these—Blake's stone-crusher—deserved to be highly spoken of. It was capable of breaking an immense amount of material in a preparatory sort of way, leaving it to be reduced to a smaller size by other means. Having exhibited models of this and other like contrivances as applicable to lead and other ores of that description, he remarked that for tin and gold, where the material had to be reduced to a very small size of grain, the miners most commonly resorted to the use of "stamps." Although crushers and stamps were the best means of reducing some classes of ores, two or three other kinds of apparatus came into play in foreign mining, as in Chili and Mexico. In dealing with the majority of cases it was not desirable always to grind the material to powder, but simply to small grains, which would not be liable to be blown or washed away. The Spanish arrastre had been used in this country for some time. It was a circular trough, in which blocks of stone were drawn round by mule power. It was now at work in the Potteries for the purpose of grinding flints. A suitable space was enclosed, and the floor was composed of large blocks of chert from the mountain limestone, and of blocks of the same material driven round until the flints were ground to a fine powder, and were taken out in a sort of cream-like liquid for use. A similar apparatus was used for grinding the quartzose veinstone, in which gold was frequently found; and in certain gold mines in the North of Italy, which had been attended with great success, a similar plan on a smaller scale had been used. The objection to this method was that the material was brought to so fine a powder that a large quantity of the precious metal floated away with the water, notwithstanding the greater specific gravity of gold. Modifications, however, of this apparatus were easily made. Another contrivance was the Chilian mill, which was very like the mill in which mortar was worked in this country, which was very well suited for tinstuff. The Californian gold discoveries had led to the formation of a number of different classes of apparatus, many of them by persons not conversant with those already in vogue, and by degrees all had been found wanting, and the miners had been glad to fall back on the old stamps, which had been proved by two or three centuries experience. The lecturer then exhibited models of the Saxon, Hungarian, American, and Cornish apparatus. The modifications of this implement were, however, innumerable. In many mines this work was carried on upon an enormous scale, in consequence of the necessity of getting through a large quantity of material. There were mines in Cornwall where they got through 30,000 tons in a year, while in various foreign mines from 60,000 to 100,000 tons were not unusual, and, therefore, they required a larger number of apparatus of this kind, and good engines to work them. At Shemnitz, in Hungary, and at places in Transylvania, they had no fewer than 2000 heads of stamps going night and day, and, therefore, the amount of profit, or, perhaps, whether they would pay or would not pay, would depend mainly upon the machinery employed. Iron stamps were an advantage over wood on account of their greater weight, and steel stamp-heads had been tried with satisfactory results. These heads were made of different weights, according to the nature of the substance to be pounded. If it were of an aluminous nature, 1¼ or 2½ cwts. would be sufficient, but where they had to deal with gold and tinstuffs, which were tough and hard, very considerable weights indeed were required. The methods of lifting the stamps varied in different districts; of course, they all worked in a box called a coffer (pronounced *kofer*), and formed of very strong material. Sometimes they were arranged for dry stamping when the ores were rich, and were not wanted to go through water, and in such a way as to require no second blow, the broken material passing away down an inclined grating, which separated the smaller from the larger pieces. One point in this arrangement was to have plenty of grating area, so that the material might escape as soon as pounded. To this great attention was paid in Cornwall, as a means of avoiding considerable loss; whereas in the case of the stuffs in which the metal was more thinly disseminated, it was necessary to have the coffer grate fine and uniform. With respect to the bed or bottom of the coffer, the practice in Cornwall was to select the very hardest stone that could be found in the neighbourhood, and that was preferred to an iron plate. The average height from which the stamps fall was from 8 in. to 1 ft., and if the machinery were in good working order 50 to 60 blows per minute would be given. Of course, the noise made by these stamps was overwhelming. When there were 100 "heads" going at once, speaking was out of the question. Examples of this work on a large scale existed at Redruth, at the Carn Brea and Botallack Mines, and in East Cornwall, and there were considerable variations from the ordinary systems in use in the Lake Superior districts of North America.

LECTURE LVIII.—After the stamps, however, another class of apparatus came into use in Devonshire and East Cornwall at the beginning of the last century, soon spreading through England, and then to the Continent. It was used greatly, and was one of the greatest boons ever conferred on the copper and lead mining interests. Of all the changes which had taken place in the mechanical preparation of ores, none was more important than that produced by the substitution of crushers for stamps. Crushers consisted of two rollers of cast-iron, placed on axes made to revolve towards one another—somewhat on the coffee-mill principle. Everything about the apparatus should be of the greatest strength. The rolls were generally made from 18 in. to 3 ft. in diameter. In the West of England it was usual to have only one pair of rollers, and where they were properly managed they worked better than tripple rollers; but it might be objected that more manual labour was required for breaking up the material to a uniform size where only one pair of rollers was used, so that it might be necessary to have a small pair for further reducing so much of the material as had not been sufficiently ground. The rolls should be made of the best, or No. 3 cast-iron, and it had been sought to render them still better by employing chilled iron, but this not having been found to answer well in practice, the ordinary iron was preferred, but of the very best quality. Still such was the friction of the rollers that after a few weeks wear they would present such a worn and uneven appearance that large pieces might be passed through them without even coming into contact with them. In some instances the machine was so constructed that the shell could be renewed when the rolls became very much worn, and for this purpose it was usual to keep several shells constantly in readiness on the works, so that no delay might occur. At some mines each pair of rolls were made of the same diameter and length, but at others it was preferred to make them of different lengths. Thus, at the Devon Consols Mines, where, perhaps, a larger quantity of "dradge" ore was crushed than at any other mine in the world, the first pair of rolls were 34 inches in diameter and 22 inches long. It was asserted that by making the rolls of these proportions the surfaces were kept in better condition than if they were made of the same length. The crusher in operation at the mines he alluded to was capable of crushing 15 tons of the better class of ores per hour; but if the ores were of the poorer description, the quantity would be much less, as the proportion of pyrites would be greater. He also instanced the case of a crusher of which the rolls were 30 inches in diameter, and one only 17 inches long, and the other 24 inches. This machine was capable of crushing 20 tons of a certain class of ore per hour. This amount of work, however, was not by any means that ordinarily performed by these machines but they might expect an efficient machine to grind down from 20 to 80 tons per day of 10 hours. Other questions which arose in reference to these crushers were at what rate they should be made to revolve, and ought the material to be put in dry or wet. These were very important questions, and no *à priori* answer could be given to them. It had been settled that the circumference of the rolls should not revolve at a less speed than 30 ft. nor more than 80 ft. per minute, the average being about 40 ft. If they revolved at too low a speed a proper amount of work would not be obtained from them, and if the speed were too great the material would pass through without being properly crushed. Water-power had frequently been employed to turn the rolls, the latter being connected with water-wheels, intermediate gearing having to be used to secure a proper speed. With reference to the introduction of water, it could not be denied that in some cases this was a decided advantage, as it facilitated the grinding very much. With some materials, however, it would not be desirable to introduce water—such as argillaceous ores, which required repeated washings before submitting it to any treatment whatever, and in these instances it would be found that if they put them into the hopper they would be pounded into a tenacious mass, which would only pass through the machine with great difficulty. But if the ores were associated with fluor-spar, water might be advantageously mixed with them, as it would keep the surface of the rolls cool, and would also assist in carrying the material through the different parts of the machine. The latter, indeed, was a great point in regard to the economy of the crushing process, and if the materials to be passed through were suitable, they should endeavour to so arrange the machine that a stream of water should enter at one point, and carrying the ores along with it, pass out at a further point.

The only modification of the crusher which it was necessary to mention was one used in the North of England, in which the machine was somewhat complicated by the use of three pairs of rollers working at once, by which the material was passed from one to the other, the third pair being called the "chat" rollers, and intended to reduce the material to the size of "chats," or small pieces. The importance of these processes would be at once apparent when he mentioned that the whole of the tin ore raised in Cornwall and Devon had to undergo this treatment, and the whole of the gold ore in the world, except the little found in steam works, and the vast body of material in which the auriferous grains were enclosed in California, in Australia, in Russia, and everywhere else, must also undergo in one form or another the ordeal of crushing. In conclusion, he mentioned that the works on the subject were chiefly in German and French; but a recent work by Mr. J. A. Phillips, on the "Metallurgy of Gold and Silver," was in our own language, which he could recommend.

LECTURES LIX. AND LX.—These lectures related entirely to the washing and other apparatus required after stamping to separate the various constituents of the mass from each other. The principle on which these were based was the different specific gravity of each constituent, so that as they were passed by streams of water through the "tyes" or troughs, placed at proper angles, the metals were deposited, while the lighter material was washed away. These lighter substances were, however, frequently passed into slime pits, and by a variety of such processes every particle of value was obtained, and nothing allowed to escape but valueless refuse. The different kinds and arrangements of "tyes" were gone into at great length. Buddles, cradles, jigging-sieves, percussion or stock frames, also received due attention, and the process of "panning" was described. Many of these processes might be said to be in a transition state, and great improvements would doubtless be arrived at when what was required, and the principles which were involved in the work, were better understood.

Mr. SMYTH concluded as follows:—"And now we come to the end of this long course of lectures, in which I trust I have placed before you some of the leading features of those facts and principles which are connected with a subject of such great extent and variety as mining. It must be borne in mind that, while it is utterly impossible to deal satisfactorily with the practical carrying out of operations which embrace so many points of mechanical science and practice as well as theoretical knowledge, by lectures and by reading only—lectures and reading and theoretical acquirements form an important introduction to practical mining. Those of the students who have carefully attended to the principles I have laid down, and the examples I have cited—who have made accurate drawings of the various apparatus which are used in the different branches of the science—will find themselves so prepared that when they visit mines, either at home or abroad, or when they begin the business of life, they will learn ten times as much in a given period as those who set out with no ideas as to the principles and diversities of condition and circumstance with which they have to deal. It is of vital importance in any class of mining that the manager should start with a knowledge of what is done in other districts, as the ideas of any particular district are apt to be one-sided. This makes it necessary to begin with a general knowledge of all systems and all kinds of appliances; and those who have such a knowledge will go into the practical work of mining with every prospect of obtaining eminence in their profession, and the due reward of their skill and perseverance. We now part company for the present, but should any of you visit any of the mining districts, either at home or abroad, and I can give you introductions, I shall have great pleasure in doing so." (Loud cheers.)

INSTITUTION OF NAVAL ARCHITECTS.

The annual meetings of this institution have been held in the rooms of the Society of Arts. Mr. SAMUDA, M.P., in the chair.

The SECRETARY having read the report; the CHAIRMAN said the finances of the institution had never been in a very flourishing condition, but he thought they were far from retrograding. In 1866 there was a deficit of something like 200*l.*, but now the receipts would, he believed, as nearly as possible meet the expenditure. The School of Naval Architecture was progressing favourably, and the Admiralty were seeking to avail themselves of it to a larger degree. In reference to technical education, he spoke of the great importance of superadding to practical education nothing short of the real and absolute work which was to form the staple of the life of the student. After referring to the papers to be read, he said it was highly desirable that there should be a proper appreciation and use of what he might term the new material, steel, for he did not think its value was sufficiently appreciated at present; and the advantages to be gained from its general use in shipbuilding were so great that it ought to be fully recognised, and when it was fully recognised the difficulties which existed in its manufacture would easily be surmounted.

The following papers were read and discussed:—

"On the Treatment of Steel Plates in the Shipbuilder's Yard," by Mr. ROCHUSSEN, who pointed out the superior advantages of steel for shipbuilding, at the same time dwelling with force upon the facts that the restraints and rules put upon the tests of the material used by the Admiralty, Lloyd's, the Frenh Bureau Véritas, and similar influential corporate bodies had done much to prevent a proper knowledge of the most suitable qualities of material, and further, great mischief to steel is always liable to arise from the general uncovered state of the building yards. These rules had given rise to the demand for one element of strength only, and many ships have consequently gone down or broken up under circumstances where no injury should have occurred, and many more are still floating with a false "hall mark" for sea worthiness. Since 1851 numerous steel ships have been constructed by those who, independent of insurance, sought security in the material of their ships; and especially was steel recognised for its merits, when the American Confederate war called forth a fleet of steel steamers, built with total disregard of the conditions of ordinary insurance—a sort of ocean butterflies—the thickness of their plates bordering on imprudence. Only one of these had been lost, the Lelia, in going out of the Mersey during a terrific gale.

Mr. HENRY SHARPE, of the Bolton Works, followed with another paper "On the Treatment of Steel Plates," in which he dealt ably with their practical manufacture, and especially with the nature of their proper qualities. The test is now generally made by the chemist, who analyses every cast for carbon. The ingots are then hammered, rolled into plates, and annealed; but as carbon is not the only element that tends to make steel brittle, every plate ought to be tested for ductility by bending cold one or more shearings from each. The tensile strength of steel depends almost entirely on its hardness, and experience has proved that plates with a strength of from 33 to 35 tons per square inch are the most desirable, as they possess sufficient ductility to render them safe under all circumstances, and are easily worked. There have been, however, causes of injury over which the maker has had no control, and which have helped to bring about distrust. There is no doubt that punching injures all plates more or less, and that the harder and denser the material the more it is injured. Some engineers have abandoned punching in favour of drilling, and the wisdom of this step was shown by the author to be fully borne out in experiments made by him in May last, and which proved that punching deteriorated the tensile strength of steel plates 5-16th of an inch thick to the extent of from 26·4 to 37·8 per cent. as compared with drilling, or, taking the average of the experiments, to the extent of 33 per cent. As, however, there are so many cases in which punching is more convenient and cheaper than drilling, it was considered desirable to overcome the difficulty, and portions of the same steel plates as in the former experiment were annealed after punching, when it was found that the breaking strain rose to 35·86 tons, or, in other words, that the plate was restored to its original strength. It was suggested that steel plates might be punched with holes sufficiently taper to do away with the necessity of countersinking holes with a drill, and also that this method would injure the plates much less than the method adopted, the thickness of the plates being 31-64 inch, pitch of holes 1⅝ inch, the plates not being annealed after punching, the result was that the ultimate tensile strength of the strips with ordinary holes averaged 26 tons per square inch of nett sectional area, whereas the strips with the more taper holes gave 32·527 tons per square inch, showing a difference in favour of taper punching of 25 per cent.

"On the Legal Method of Determining the Tonnage of Ships, and upon the influence of that legislation upon the form of ships, and upon recent shipwrecks," by M. E. FLACHAT. The tonnage of vessels has been established to serve as a basis for the calculation of what are called tonnage dues—that is to say, taxes levied upon vessels in ports, docks, basins, and so forth. The system gives the charterer one sole object—namely, to carry the greatest weight in the smallest possible space. It thus tends to increase the density of the ship,

in other words, to deprive it of the most precious of its nautical qualities—liveliness. Those vessels whose decks cover extensive passenger accommodation are higher out of the water, and have, therefore, a lower density. In rough water the waves rising against their sides raise the hull without washing over it. Vessels carrying merchandise only have their decks nearer the surface, and the waves, not being met by a sufficiently rapid upward movement of the ship, wash over her. The inconvenience and danger are risked because it is important to carry cheaply, and because a vessel of which the capacity—that is to say, the legal tonnage—is disproportioned to the freight it can carry pays, in every port it sails to, heavier tonnags dues than the same cargo with a less legal tonnage. The legal system of tonnage has thus considerable influence upon the form of ships. It is to the public interest that this influence should not bend in any other direction than that of the public safety and good. Is this law, then, asked M. Fiachat, justified by any advantage whatever? Volume has three dimensions—length, breadth, and height. Why not stop at length, and rest the foundation of the fiscal charge on that dimension, and not on the volume? From a fiscal point of view there is no interest in looking beyond the length of the ship.

Mr. DEKKE, of Bergen, followed with a paper "On the English Measurement of Tonnage;" a subject brought forward with a view to discussing its merits as a basis for a uniform system for the western nations.

"On Testing Iron by Magnetism," by Mr. S. M. SAXBY, R.N. The author assumes that tensile strength is an insufficient test of goodness; and further that if each particle of iron has polarity, the whole mass which is made up of any number of such particles is a magnet; inductively so if the iron is pure and soft, permanently so if in the state of steel or cast-iron. As the amount of magnetism in a piece of iron is measurable, therefore if strength in iron is magnetism, so strength should be also measurable; and as any common compass is a magnetometer, so ought we to be able by the use of a compass to measure strength in iron and detect its weaknesses. Many details were given to show the value of the process.

At the evening meeting the papers read were "Description of Double Expansive Engines for Her Majesty's Ship Sparton." "On Liquid Fuel," by Captain Selwyn, Royal Navy: and on an "Improved Liquid Boat Compass," by Mr. J. McGregor.

On Friday the Earl of HARDWICKE took the chair. The principal paper was that "On Fixed Central Batteries," by Capt. T. E. Symonds, R.N.

The other papers were:—"A Monitor for Coast and Harbour Defence, and on Submarine Artillery," by Mr. J. H. Longridge. "On the Turret and Tripod Systems of Capt. Coles," by Vice Admiral Halsted. "Muzzle-pivoting Gun-carriages for Naval Armaments," by Capt. Heathorn, R.A. "On Naval Construction, from 1800 to the present time, and its probable future," by Vice Admiral Sir E. Belcher. "On the Application of Portable Buffers, or Springs, to Cables of Ships Riding at Anchor," by Mr. R. Saunders: and "On the Reverse Currents of and Slip of Screw Propellers;" by Mr. A. Rigg, jun.

On Saturday:—"On the Stability Monitors under Canvas," by Mr. E. J. Reed, Chief Constructor of the Navy. "On the Position of the Centre of Gravity of the Greek Armour-clad King George," by Mr. G. C. Mackrow. "On a Sea-going Turret Ship," by Admiral Paris, C.B., of the Imperial French Navy: and "On Waves which Travel with Ships," by Prof. Rankine.

INSTITUTION OF CIVIL ENGINEERS.—At the ordinary general meeting on Tuesday, Mr. C. H. Gregory, president, in the chair, twenty eight candidates were duly elected, including nine *Members*:—Mr. W. C. Barton, chief engineer of Travancore; Mr. J. Bower, Whitehall; Mr. W. W. Clarke, executive engineer, P.W.D., N.W.P., India; Mr. R. S. Clayton, Ripley; Mr. F. J. Dennys, resident engineer to the Salford Water Works Company; Mr. J. Mathias, Craven street; Mr. J. Paton, general manager and engineer to the Blaenavon Iron Company; Mr. G. L. Reid, chief engineer of the Great Western Railway of Canada; and Mr. D. Richmond, deputy chief engineer of the Bombay, Baroda, and Central India Railway; and twenty-nine *Associates*:—Mr. H. G. Anderson, Brighton; Mr. F. C. Baron, assistant engineer on the Central Argentine Railway; Mr. W. T. Blacklock, Manchester; Mr. W. R. Browne, Bristol; Mr. R. H. Brunton, chief engineer for Lighthouses, Harbours, Roads, &c., to the Japanese Government; Mr. C. T. Casebourne, West Hartlepool; Mr. R. G. Clutton, Whitehall; Mr. C. H. Croudace, Euston-square; Mr. H. A. S. Fenner, assistant engineer, P.W.D., N.W.P., India; Mr. W. R. I. Hopkins, Middlesborough; Mr. W. S. Howard, executive engineer, P.W.D., Bombay; Mr. A. Longsdon, New Broad street; Sir A. W. Mackworth, Bart., R.E., Aldershot; Mr. R. Reynolds, Boston; Mr. F. W. Robinson, assistant engineer on the Riga-Dunaburg and Dunaburg-Witepsk Railways; Mr. R. B. Smyth, F.G.S., secretary for mines to the Government of Victoria, Melbourne; Mr. W. Sykes, Toronto; Mr. J. J. Wallis, Blaenavon Iron Company, Cannon-street; and Mr. D. W. Young, Westminster. It was also announced that the council, acting under the provisions of section 4 of the bye-laws, had, since the last announcement, admitted as *Students* of the institution, J. A. Carfrae, J. M. Gibson, C. S. Harris, G. E. Page, and F. G. Wynne.

SOCIETY OF ENGINEERS.—At the meeting of members on Monday (Mr. Baldwin Latham, president, in the chair) a paper was read on "The Sewerage Works at Redhill," by Mr. Sydney A. Reade, M.A. The following candidates were duly elected as *Members*:—Messrs. James A. Hay, Royal Arsenal Woolwich; Richard Dudgeon, London Wall, and Columbia-street, New York; R. J. Hutton, Fairfield, Glasnevin, Dublin. As a *Foreign Member*: Lieut. George Gordon Bigsby, Royal Engineers, Executive Engineer Public Works Department, Bengal. As *Associate*: Mr. John Thompson, Nettlebed Potteries, Oxfordshire.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.—The ordinary monthly meeting of members took place on April 4, at the George Hotel, Aldermanbury, City. The chair was filled by Mr. J. Newton, Her Majesty's Mint, and there was a fair attendance of members. Several nominations and elections having been made, the Chairman took an opportunity for congratulating the engineering trade in general upon the recently-announced munificence of Mr. Whitworth, and said that gentleman had earned for himself the gratitude of every mechanic in the United Kingdom by founding scholarships for the promotion of technical and scientific education, and future generations would reverence his name. In a very humble way their institution had long laboured for the elevation of the mechanical classes of this country, and it was gratifying in the highest degree to find themselves now in company with so distinguished a fellow-worker as Mr. Whitworth. He (the chairman) was not without hope that some among the associated foremen might one day find their sons receipients of the advantages to be derived from the Whitworth scholarships. It was a fact of which all might feel proud that Mr. Whitworth was an honorary member of the Association of Foremen Engineers, and entertained the most cordial feelings towards it. The chairman's remarks were much applauded., and then the further business of the society, which was of a practical character, was proceeded with. An "Indicator of Speed and Distance" was exhibited and described. It is applicable to machinery in motion, and to coaches and carriages. By very simple mechanical means the indicator registers the number of revolutions up to 1,000,000,000. After this it is re-adjusted at zero, and commences counting *de novo*. The ingenious inventor is Mr. Hay, of 83, Lombard-street, and the apparatus costs only 3*l*. or 4*l*.

SOUTH WALES INSTITUTE OF ENGINEERS.—The general meeting of members will be held at Cardiff, on Wednesday, when the discussion of Mr. G. Cope-Pearce's paper "On Mechanical Ventilation" will be resumed; the paper "On Patent Fuel," by Mr. A. Bassett, will be discussed; and the following papers will be read and discussed:—"On Davies' Self-Acting Steam Striker," by Mr. D. Davies; "On Over-Winding, and how to prevent it," by Mr. W. Fairley; and "On the Assurance of the Lives of Miners and Colliers," by Mr. Chris. James.

LIQUID FUEL.—Messrs. J. L. NORTON and G. HAWKSLEY, of Ludgate-hill and Caledonian-road, have patented an improved mode of burning liquid fuel. The improvement consists in forcing the material to be burnt through a longitudinal orifice, formed by placing two plates together. The plates are held together by a spring, and the orifices are surrounded by a cone, so that air may be forced in with the liquid fuel, upon the plan of a Gifford's injector. A smoke-like inflammable mass is obtained by this means, and the flame is guided by a series of columns in the furnace space.

THE LIME LIGHT.—The arrangements for supplying Perth Barracks with the lime light are being rapidly proceeded with, and before long we hope to see it demonstrated there that this beautiful illumination is as applicable on private buildings, and in a small way, as it has hitherto proved to be on an extended scale. Its principle is exactly the same as that known as the "Drummond light," but some slight improvements have recently been introduced into its working. Three substances are concerned in the production of the light—two gases, oxygen and hydrogen, and a solid—lime. The mode in which these are used is as follows:—A jet of hydrogen being lighted a jet of oxygen is turned on so as to mix with it, and the solid incombustible lime being so arranged as to be exposed to the intense heat it emits a light so pure and so powerful that it is only rivalled by that of the sun. The method of using and lighting the jet is precisely the same as with a common gas-burner; so that no special knowledge or instruction is requisite for its management. Where the consumption of the lime light gases does not exceed 1½ ft. per hour, the light produced is equal to four gaslights, each burning 5 ft. per hour. Three feet per hour give a light equal to 15 gaslights, each burning 5 ft. per hour. Six feet per hour give a light equal to 60 gaslights, so that 6 ft. are equal to 300 ft. of gas. The two gases may be easily produced, and a very small main would be sufficient to convey them through the streets for the lighting of dwelling-houses, a purpose for which this light is singularly well fitted, as its products of combustion are quite innoxious and have no tarnishing effects. Another advantage is that it exercises no changing influence on colours, every tint being as distinctly observable by its assistance as in the light of the sun. Various towns in Scotland are adopting the light, and if, as will doubtless be the case, the experiment at Perth proves satisfactory, the lime light will gradually supersede the use of gas.—*London Scotsman.*

CRYSTALISATION.—A very curious discovery has recently been made by M. Auguste Bertsch, and turned to practical account by M. Kuhlmann, the celebrated chemist. Who is there that has not, during cold winters, stopped to admire the beautifully symmetrical and yet fantastic figures of leaves and flowers depicted on the window panes of a well-heated room, the air of which is charged with aqueous particles? M. Bertsch has found that Epsom salts (sulphate of magnesia) dissolved in beer, together with a small quantity of dextrine (artificial gum), and in this state applied to a pane of glass with a sponge or brush, will, on crystalising, produce the identical designs above alluded to, hitherto considered peculiar to water; with this improvement, however, that the liquid may receive any colour whatever, at the option of the operator. The ephemeral productions of frost may thus be easily perpetuated; but M. Kuhlmann, on being apprised of the fact, conceived the idea of going a step further, and transferring those fairy-like creations to stuffs and paper. For this purpose he first got the crystallisations on sheets of iron, on which he afterwards laid one of lead. By means of a powerful hydraulic press the minutest details of the figures in question were durably imprinted on the soft metal, and a copy of them in relief was then obtained by galvanoplastics. But here another difficulty arose. In the impression of cotton stuffs the pattern must be continuous; whereas in M. Kuhlmann's plates the lines at one end would clearly not coincide with those at the other, so that disagreeable interruptions would be caused in the printed designs. This obstacle, however, has been overcome in a most ingenious manner by effecting the crystallisation on the cylindrical surface of a roller. A slight rotatory motion imparted to it will prevent the liquid from accumulating at any particular point before it has evaporated.—*Galignani.*

Original Correspondence.

THE INCORPORATED ASSOCIATION OF MINE AGENTS OF SOUTH STAFFORDSHIRE AND THE LOCAL GOVERNMENT INSPECTOR.

SIR,—In a recent number of the *Mining Journal* you were pleased to refer to this association at considerable length, and in reviewing the proceedings of their first annual meeting—after giving South Staffordshire credit for a great reduction in accidents during the last ten years—remarked rather strongly upon a presumed antagonism which you say exists between the members of this association and the local Government Inspector, Mr. James Philip Baker. Having laid your remarks before the members, I, as their honorary secretary, am instructed to say that it is not the association who are at war, or wish to be the least unfriendly with the Inspector, but if any such feeling does exist between him and the association it is of his own creating. A reference to the reports of the judicial proceedings in the local press since his appointment will amply testify his prosecutions, under the Mines Inspection Act, against the mine agents of the district having been marked by unnecessary severity. These, and his own determined unfavourable interpretation of the special rules against the mine agents and in favour of the men, and the leaning to those views by the stipendiary of the district, gave rise to some extent to the formation of the association. But it was at the same time felt very desirable that an opportunity should be afforded the mine agents of the district to meet for the discussion of all matters relating to their practice, the good result of which you have already so kindly referred to in the article before alluded to.

In a very recent prosecution (which was dismissed), in which the Inspector was pressing for a conviction without reasonable cause, the learned stipendiary had to remind him "that he (the Inspector) may depend upon it that a better state of things would not be brought about by convicting people wrongfully." The stipendiary at the same time remarked, "that he had read with very great interest the papers read at the meetings of mine agents at Dudley."

I do not think there is a single member of the association but would be glad to see the Inspector at their meetings, and to listen to any communication he had to make. Indeed, he has been invited to do so, but hitherto he has not responded to that invitation. We all agree with you, Sir, that the Mines Inspector of a district ought to be a leading member of any scientific mining institute in his district, and take a prominent part in its discussions, and be open at all times to render kind advice or assistance in cases of emergency; but if he cannot or will not do so I do not see why its members should be publicly blamed. Previous to his appointment, and during the meetings of the mine agents, held here ten years ago for the discussion of the then special rules, no mine agent spoke louder than Mr. Baker did for the individualising the responsibility of mine management. Since his appointment, however, he attempts to concentrate it all on the mine agent, and by that means encourage every species of carelessness and insubordination in the inferior officers and workmen. We quite agree with you that this state of things should not exist between the association and the Inspector of the district, and it is to be regretted that there should be cause for any misunderstanding at all. The association are quite willing to remove any obstacles on their part, if there be any, to a reconciliation of a friendly disposition between the Inspector and its members, if he will only point out what they are.—*Dudley, April* 8. HENRY JOHNSON, Hon. Sec.

THE SHROPSHIRE COAL FIELD—No. I.

THE GREAT EAST, OR SYMON, FAULT.

SIR,—In writing to the *Mining Journal* a few weeks since on this Fault, I stated that my engagements then prevented me enlarging on the subject. The importance of the question, however, and the interest with which it is surrounded, induce me now to lay before the public a few thoughts, somewhat hastily formed. In a communication in October last I gave you an account of the discovery of coal at the Kemberton pits, and in doing so I was particularly careful in wording my remarks, so as to prevent the misapprehension into which Mr. Parton appears to have fallen in the *Colliery Guardian.*

After giving some particulars, I said—

"It should, however, be clearly stated, in order to avoid misunderstanding, that the discovery now made is not that of a new coal field, or even a portion of one. It only proves the expansion of the old one beyond the limits previously assigned it; at the same time it affords no evidence whatever of the continuance of the seam for any great distance in the line now taken from former workings in the direction of the south-east. On the contrary, it affords ground for caution to any who might be disposed to speculate upon finding the same seam (the Top Coal) beyond the boundaries of the land under which the Madeley Wood Company have the right of working, in the direction of Shiffnal, as additional indications are not wanting of the near proximity of the Great East or Symon Fault, which Mr. Marcus W. T. Scott, F.G.S., has laid down in his paper, read before the Geological Society of London (1861), on that subject."

There is no doubt in my mind that the entire credit of the discovery, both of the direction and true nature of the fault, is due to the researches of Mr. Marcus Scott. On the surface there are irregularities in the rocks, which might very pardonably have led to the supposition that the Great East Fault is of the same character as the Limestone, the Lightmoor, the Ketley, and other similar faults which intersect the coal field; and it was only by facts carefully collected and arranged by Mr. Scott that he first, and others afterwards, came to the conclusion that it was the line of an ancient valley of denudation. Mr. Edward Jones, a gentlemen of very great sagacity, who is mining engineer to the Lilleshall Company, also came to the same conclusion, as may be seen from "The Explanation of the Horizontal Sections (sheet 54) of the Geological Survey of Great Britain," by A. C. Ramsay, F.G.S., and published in 1859. Mr. Ramsay having given his reasons why the Great East Fault had been drawn on the Ordnance Map as an ordinary dislocation, says—

"I was, however, informed by Mr. Jones, of Lilleshall, that near Priors Lee it was not a true fault or dislocation, with a downthrow on the east, but an *ancient denuded cliff*, or rather slope of coal measures, upon and against which the Permian strata were deposited. It is believed that this arangement stretches south along the boundary of the coal field, and it is, perhaps, likely that it may extend to Cuckoo Oak, where the line is crossed by the section; but being uncertain, the fault is retained in deference to old opinion, and to the fact that a fault not far off points towards it."

Mr. Scott had superior opportunities of collecting data on which to form an opinion of this very remarkable feature of the coal field, and he availed himself of them, and turned them to account; hence the very interesting paper he read before the Geological Society in April, 1861. In this paper Mr. Scott tells us that he found a series of coals after continuing considerable distances to disappear one after the other in a descending order, the lower one stretching nearly a mile beyond the first; and the amount of matter so denuded may be imagined from the fact that the vertical depth from the first denuded seam of "Top Coal" to that of the lower "Randle" and "Clod Coal" is something like 150 ft. Mr. Scott also observed whenever he came to the denuded edges of one of these seams, or to any intervening coal or ironstone members of the series, that they were overlaid by a rough gritty rock, red, yellow, and blue, varying in thickness from 1 to 15½ ft., and locally called calamincar.

The sinking of the Kemberton pits so near the fault subsequently afforded excellent opportunities of observing the edges of the denuded strata at a point still further to the south. The strata passed through in the descent were, we may remark, comparatively new to the old sinkers, whose chief experience was gleaned in the old-established portion of the field to the west, but similar to that gone through by the sinkers at the new Stafford pits, in the Lilleshall Company's field. Like the latter they passed three or four thin and worthless coals, and then came upon a stratum consisting of a mixture of hard red, white, and yellow fragments of local rocks, called calamincar, usually the first decided indication of denudation. We paid particular attention to the specimens found on approaching the fault as they were brought to bank, and found that they corresponded with the description Mr. Scott gave in his very valuable paper.

The Top coal, the first of the workable seams in the Madeley Wood field, was found to be partially denuded, and the upper portion, called the hard-tops, were gone. There was no mistaking the agency by which the seam had been partially destroyed from the appearance of the coal where it abutted on the fault: it was cracked, split, and the interstices filled up with the sediment or silb of the waters which had done the mischief. In some instances even we detected portions of coal which had been broken off, and subsequently had become the sport of the waves or current of water which displaced them. The coals lower down, including the Little Flints, which will, it is expected, be reached this week, are all, as might have been expected, in their proper place, and unaffected by the Symon; but it is more than probable, however, that all excepting the lower coals will disappear one after the other in following them to the east. And what makes the case more serious is that in no one instance have they been found to come in again, as in ordinary faults. The line of the fault is neither straight or angular, as is usually the case in slip faults; on the contrary it follows a serpentine course, like an ordinary indented coast-line of modern times. If we follow it further to the south we find still further evidences of the ravages of this destructive element, till finally the lowest of the series disappears, and the very foundation of the structure has been cut away.

It is from the south, therefore, it appears to us that the remorseless waves came rolling in which robbed us of so much mineral wealth, and the important question suggesting itself is—How far did their ravages extend to the east? Were they arrested by some carboniferous barrier, which lies buried between the New Red Sandstone, midway between the east of the Shropshire and the west of the South Staffordshire coal fields? Were some of the coal seams so deeply concealed amid the hollows of the Silurian basin as to escape, or did this destructive agency make a clean sweep of every acre of coal between the present boundary lines of the two coal fields?

It is rather ominous that we find precisely the same appearances on the South Staffordshire side. We quote from a paper read at a meeting of mine agents of South Staffordshire and East Worcestershire, in January, which describes a heading driven, with a view of ascertaining the probable extension of the coal field in a western direction, from a shaft sunk within a short distance of the Permian sandstone, down to the Thick coal, 130 yards. The author, Mr. W. Spruce, says:—

"The end of the thick coal and other measures, abutting against the Permian fault, have a most unusual appearance, being exactly contrary to the general rule. * * * For about the first fifty yards of the gate-road leading to the great fault the Thick coal is pretty much in its entirety, but is cut up by a great number of downfalls dipping towards the main fault; but for the remaining 30 yards nearest the fault it loses all its regular bedding, is very soft, mushy, twisted, and much contorted in all forms, and the end of it rises in a feather edge very abruptly against the Permian measures, instead of dipping, as it does in most cases, along the run of the same fault. The Heathen coal rises nearly upright with a similar feather edge, against the Permian measures. The heading driven into the Permian rocks shows that they dip away from the coal field at an angle of about 60°."

Mr. Scott in his paper both describes and figures similar appearances, and in a heading similar to the one described by Mr. Spruce, driven from the Shaw Field Pit, a pit south-east of those described by Mr. Scott, we noticed precisely the same kind of vertical slips in the coal on approaching the fault which the former gentleman describes, also the same thinning out of the minerals. And in following the barren grey and red sandstone rocks which come in and displace these coal seams to the south, we observed not only what we believe to be clear indications that the great storehouse of coal and ironstone has been cut down and carried away altogether, but thousands of feet of the foundation rocks themselves have been similarly removed, and that their denuded surfaces have been laid over in some instances with two or three small impure seams of coal, belonging altogether to a subsequent period.

Nothing will be easier than to show that not only during the carboniferous, but prior and all subsequent times, in consequence of the oscillations of the surface, large displacements of strata have taken place, whilst newly-formed rocks, made to overlap and dovetail in between formations of widely different periods.

Whether the destructive effects of water or the atmosphere were greater, owing to larger proportions of certain elements at any former period than at present, or whether we allow the same time for the waste and re-formation of strata by these powerful geological agencies now required, the changes they have wrought, and the effects they have produced are among the most interesting which occur to the geologist in his endeavours to make out the physical structure of the earth. —— JOHN RANDALL, F.G.S.

PREVENTION OF SMOKE.

SIR,—It was discovered many years ago by an official connected with the City of Dublin Steam Packet Company that "silver" was an effective smoke preventer—more effective than any of the mechanical arrangements which had been patented; and as there have certainly been no smoke-preventing novelties since that time, I do not see why those who are plagued with complaints that they make too much smoke should not now adopt his suggestion, with advantage to themselves and their neighbours. The theory of the prevention of smoke is very simple; it is only necessary to secure the burning of the gases, instead of letting them escape unconsumed up the chimney; and in every invention which has yet been brought forward the object sought to be achieved is the passage of the products of the newly-supplied coal over that which is already a bright red. One class of inventors has endeavoured to accomplish this by turning the gases back with a deflector placed behind the fire; another has employed two furnaces, and fed them alternately; and the third has supplied additional air, so as to mix with the gases, and facilitate their burning on the incandescent mass. Now, all these automatic arrangements are rendered unnecessary if the stoker exercise ordinary care. All he has to do is to well push back the red-hot coals in the furnace, and feed the fresh coal near the mouth; and, consequently, the steam company mentioned found that they had only to give the men 2*s.* extra upon their week's pay if they avoided making smoke, and fine them 1*s.* if they made smoke, to ensure an entire absence of the nuisance, and increased economy in the use of—

April 7. —— COAL.

LIQUID GAS.

SIR,—I read with considerable interest the article upon liquid fuel published in last week's Journal, and was equally struck with two facts. In the first place, I think few were aware that so long a period as 35 years had elapsed since Mr. Rutter's first proposal to employ bituminous substances in a liquid state; and, secondly, I was much surprised at the small number of classes into which the whole of the liquid fuel patents were divisible. Indeed, it seems that we may regard all inventions as being based upon the principle of burning the liquid as it issues from small orfices, placed so that the flame may occupy the same place as that of an ordinary fire; or else upon the principle of converting the fuel into gas, and then using the gas under the boiler. Of course, whether one or other of these systems be preferable would in a measure depend upon the nature of the fuel being burned, for it must be obvious that where there is such want of volatility in the fuel a large amount of heat would be required for its conversion into gas, and the loss would be material, as the heat so employed would be better applied in heating the water than in heating the fuel; but when very light mineral oils are used the conversion of them into gas before burning them might be advantageous. The facilities for burning in the form of gas would be greater, and the only question which would decide the use of the fuel in any other way would be the cost and trouble inseparable from all gas-making processes.

But whether it be attempted to use liquid fuel in its normal state, or converted into gas, there are, I fear, objections to it which would altogether prevent its introduction upon a commercial scale. Compared with coal, liquid fuel is practically untransportable, and the supply of a ship, even supposing it to be employed for marine boilers, would be limited to a single cargo at the place of manufacture, because the re-filling of a ship's oil tanks, in the same way as her coal bunkers are now re-filled, would necessitate the use of innumerable casks, the cost of which at the place where the fresh shipment of fuel is to take place would alone be equal, and often greater, than the cost of coal of equal steam-generating value. And as to the carriage of liquid fuel in the ship wherein it is to be burned, there would be many objections, apart from its liability to ignition. With solid fuel the breakage of a coal bunker does not jeopardise the ship, nor does it lead to the loss of the fuel, but the fracture of a liquid fuel tank on board ship would render the atmosphere of every place below deck insufferably offensive, and would probably result in the loss of the fuel, which would under the most favourable circumstances find its way to the hold to improve the odour of the bilge-water.

The most decided objection which I think exists against liquid fuel, however, is its great cost, as compared with coal—that is to say, for the quantity necessary to perform a given amount of work The most

favourable results which have yet been obtained are those reported in connection with the experiments of Mr. Richardson, at Woolwich Dockyard, and the only conclusions which they lead to are, that it is possible, with extreme care, to do as much work with half-a-crown's worth of liquid fuel as can be done with one pennyworth of coal. This is allowing the mineral oil used to be obtainable at a cost of only 5*l.* per ton, though it is at present much higher, and that the coal tried against it is of only average, and not selected, qualities. But little progress seems to have been made in the burning of liquid fuel during the past 20 years, and it is still found to be scarcely economic, although not quite impracticable, to burn the heavy oils, which alone are available (in consequence of price), even at the works at which they are produced. In proof of this, reference need only be made to the system used at the works in Flintshire at the present time, and to the beautiful arrangements of the Irish Peat Company at Athy some few years since.—*Dublin, April 8.* S. W.

ON THE WASTE OF MINERAL AND OTHER NATURAL PRODUCTS.

SIR,—In the previous articles I limited my observations to the value of fish and its offal—substances now regarded either as useless or too obnoxious for treatment in a mercantile point of view, and have endeavoured to prove that by means of simple and inexpensive methods they may be converted into an agricultural auxiliary, and become a source of certain and large profit to investors of capital. Statistics, prepared upon the basis of actual experience, justify me in estimating annual profits of at least 30 per cent. upon capital expended, even at an early stage of the adventure, whilst, with the advantages contingent upon practical working, and the adoption of those appliances which positive operations engender, the profits would admit of commensurate augmentation.

As a corollary, both in the shape of income and a means of improving the product, other manufactures might be supplemented. Of these, the most important and feasible are bone-ash and sulphuric acid, both articles intimately associated with the question of successful production of artificial manure, and both important considerations in the locality upon whose industrial resources I am endeavouring to arouse public interest.

At some distance from the scene of proposed operation, but to and from whence the means of transit are becoming daily more facile, lies the State of Texas, U.S. From the almost boundless prairies of this district are annually exported enormous quantities of horses, cows, and sheep, besides vast loads of hides of different kinds, and, consequently, bones are obtainable in profuse abundance, at prices remarkably low, as compared with the same articles in the "old country." The favourable terms upon which these may be secured offer an inducement of no ordinary nature to combine a trade in bones with the product derived from the fish, for after selecting such as command a superior price for the purposes of cutlers and others, who exercise their skill in converting bone into articles of use and ornament, the coarser portions, by incineration, would constitute bone-ash, and by the action of sulphuric acid would yield superphosphate of lime, both exceedingly rich in the essential element of phosphates, and thus becoming inestimable adjuncts to prepared fish manure, should ulterior arrangements embrace the production of artificial fertilisers. At the same time, other highly valuable products could be eliminated, all of which meet with a ready and profitable market on both sides of the Atlantic. Inexpensive arrangements and unskilled labour would, from the fatty and gelatinous constituents of the fresh bones contribute largely to increased profit, by the fabrication of tallow and glue. Beyond all these auxiliary aids, the bones themselves may be rendered subservient to the purpose of fuel, inasmuch as in the process of calcination it is essential that the heated mass should be freely exposed to the action of the atmosphere; and after the process of boiling, for the sake of separating the fat, a sufficient portion of oily matter remains in the bones to constitute them an excellent heating medium.

It should be borne in mind that of late years experience has verified the predictions of theory with respect to the over stimulating properties of Peruvian guano when its influence exceeds the mineral elements, the phosphates in particular. This hitherto popular fertiliser has not fully realised the anticipations of those who have relied upon its virtues, whilst the prejudices against mineral phosphates, as coprolites and apatite, are found to be based upon correct data. Hence the demand for the phosphates obtained from bones is becoming more exhaustive of them, and results in a rapidly increasing monetary value. Tracing the cause of the reaction to its source, it is clearly attributable to the fact that, whatever the origin of the fossilised phosphatic principle, the process of converting the excreta of extinct animals into its mineral condition has dissipated every trace of ammonia, an element, when judiciously incorporated, of incalculable value in a manurial point of view. Referring to the unerring rule of statistics, I find that, according to the returns published by the American Government, in the year 1861, there were exported from Texas 241,825 horses, 2,225,027 heads of cattle, and 336,937 sheep; and from the small ports of Lavaca and Sabini Pass respectively 37,587, and 11,765 hides. The returns of later years I have been unable to obtain, but it is reasonable to infer that at the present time the exports are at least quadrupled. Thus, estimating the export of hides from Port Lavaca last year, as I am credibly assured was a pretty correct standard, at 80,000, and calculating each beast at 560 lbs., averaging 112 lbs. of bone, we have at once 8,960,000 lbs. of bone, the loss of weight upon which, by calcination, being equal to one-half, the total weight of bone-ash resulting will be 2000 tons, at (say), such being a fair mercantile value, 5*l.* per ton—gross, 10,000*l.*, yielding a first or manufacturers' profit of 5000*l.* Relative to cost of production, a capital upon this branch of 2000*l.* may be reasonably considered ample to cover all contingent expenses in the purchase of raw material, erection of furnaces, travelling expenses, labour, and superintendence, until a shipment of some 300 tons could be effected.

A further, and most material, auxiliary to a profitable development of the resources of the district of Newfoundland is the manufacture of sulphuric acid, and for which the facilities are unusually great. There the sulphides of various metals, especially of iron, exist in profuse abundance. This iron pyrites, with its 45 per cent. of sulphur, is at present, for all local purposes, perfectly valueless, though the excellence of its quality induces a great demand for it in the English market. Here it is chiefly employed in the manufacture of sulphuric acid, and is found to be the most economical source of obtaining the acid, despite the heavy charges of freight, &c., from the far distant colony whence it comes. In Great Britain sulphuric acid of specific gravity and purity sufficient for making superphosphate of lime, can be had for about 3*l.* per ton. In Nova Scotia and Newfoundland, there being no manufacture of it in that district, an equal quality realises 18*l.* per ton, and this acid is obtained from Boston, U.S., the nearest point of its production. Let us suppose the acid to be manufactured on the spot where the principal constituent is obtained at a mere nominal cost, where labour is cheap, where freight, carriage, and such like incidentals are saved, and where the really serious item of broken carboys and incessant destruction of baskets are obviated, and we may surmise the extent of economy exercised in establishing sulphuric acid works in conjunction with an artificial manure manufactory, especially when it is borne in mind that the consumption of the product over the district, and in the nearest States, is becoming a question of some magnitude, to say nothing of the rapacity of the sugar plantations, and the incessant demands of tobacco cultivation, for so vital an element of vegetous growth and prosperity; and the locale of both these important principles is within the commercial sphere of the projected manufactory.

Briefly, then, I have endeavoured to show that in the vast fields—or rather waters—of Nova Scotia, the Magdalene Islands, and Newfoundland there exists an immense superabundance of fish, whose waste and offal are procurable at little more than the merest cost of labour, and which, with proper and very inexpensive machinery, and other appliances, can be utilised, both to the profit of investors and to the signal and lasting advantage of the cultivators of British soil, giving employment at the same time to a vast population of our colonial dependencies; that the demand for the resulting product will, at remunerative profits, be as illimitable as the production itself. Also, that in the prairies of Texas, with gradually increasing facilities for transit, is an almost inexhaustible storehouse of bones, procurable upon most advantageous terms, which at a trifling outlay for machinery may be converted into a satisfactory profit; and, lastly, that the inducements for extending operations, so as to include the manufacture of sulphuric acid on the field of the primary operations, are *bona fide*, and savour of great advantage. The requisite capital I estimate at from 25,000*l.* to 30,000*l.*, which, judiciously laid out, would suffice, and could not fail to yield satisfactory results.

To recapitulate, the features of success are—1. Supply and demand are equal, and both practically inexhaustible.—2. The raw material is obtainable at a mere nominal cost above that of labour.—3. No difficulties present themselves in the form of complicated apparatus, or delicate manipulations.—4. Labour is plentiful and, owing to the primitive habits of the islanders, cheap.—5. For the amount of productive business the requisite capital is extremely small: whilst, lastly, not only will the profits be large but, the products commanding ready money, commercial losses will be very trifling.

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TIN AND COPPER MINING.

SIR,—It is very satisfactory to find that tin has at last taken a step in the right direction, an advance of 2 took place on Monday after the meeting of the smelters at Truro. Copper has also advanced to 118 standard. Last year the standard was considerably below 100. Such a low price for the ore compelled the stoppage of a vast number of mines producing this mineral. Neither can many of the old and nearly exhausted mines meet the charges or working cost at the present quotations, either in this country or abroad. The great depth of several of our long-standing mines, with a serious falling off in the quality of the ore, as well as quantity, higher prices must be obtained, or many more old mines must shut up. The greatest mines in Chili, Cuba, and Australia, we are informed on good authority, have been very losing branches of commerce the last two or three years of great depression in trade. The falling off in the production of copper throughout the world is at least 40 per cent., the stock throughout Europe lower than for many years; in fact, nearly exhausted. Capitalists should turn their attention to the discovery of new mines, which invariably pay the speculator better than embarking in deep and exhausted mines. It is possible to make a chain which will not hold its own weight, so with respect to embarking in old mines.

The greatest drawback at present against embarking in mines on the Cost-book Principle is the tyranny of the Stannary Court, and Cornishmen who wish well to mining and their country should take care to attend to their interests in the coming election, and vote for no man who would not pledge himself to use his utmost to alter or abolish such mischievious laws. AN ADVENTURER IN MINES.

Penzance, April 8.

MINING INVESTMENT AS IT WAS AND AS IT IS.

SIR,—The present condition of the mining interest is altogether anomalous, and it is important to investigate the causes which have produced the present state of affairs, and also to present the realities of the case before the public. At no period previous to the present has anything like the strange combination of circumstances been seen in connection with the business of mining. The metal markets show a tendency to advance; commerce is slowly and almost, one might say, sullenly reviving; money is abundant in all the great markets of Europe, except Vienna and St. Petersburgh, yet the mining interest seems utterly paralysed—in the midst of life there is death. With abundance of capital, skill never before possessed in any age or country, with improved machinery, and a marvellous advance in the sister sciences of geology and mineralogy, hardly any discoveries are made in the British Isles; regions which are, undoubtedly, metalliferous, remain undisturbed, mines that used to pay are now silent, and no capital is forthcoming to renew their operations or work others. It is true that there are still some great British mines active, such as the Devon Great Consols, and larger profits are made by mining companies than are returned by any other description of enterprise whatever, but even that fact, all-important as it is, does not stimulate investors to embark in mining. In the Share Market very little is done, except what is speculative. Shares in good companies do occasionally change hands as an investment transaction on the Mining and Stock Exchanges, but generally the speculators alone are the operators. The "bulls" and the "bears" still bellow and growl, still butt and hug; but such activity brings no profit, except to the class of speculators who may happen to be in luck; and the victims, who for the most part belong to the general public, are disgusted with the business altogether, and generally retire, vowing they will never again have anything to do with shares in mines.

Recently there has been a hardening of discounts here and on the Continent, and this has been taken as a sure sign that business is reviving, and that the brisker movements of commerce create a more active demand for accommodation. No sign, however, appears of any ruffle upon the stagnant surface of this most important branch of our home industry. It was said some time ago, by experienced persons, that mining would not revive until the money market became more active, because the stillness of the discount business, and the accumulation of money in the Bank, proved the absence of all confidence on the part of investors in anything wearing the slightest appearance of the speculative. Well, business in money is now showing signs of active life; discounts in the open market range as high as the Bank minimum. In Paris, the interest of money is rather higher than here, and in Frankfort, Frankfort-on-the-Maine, Berlin, Hamburg, Brussels, Amsterdam, and the Hague, the price of money is from ½ to ¾ above that of the market here. But with these indications of reviving commerce there are no symptoms of the fulfilment of the prediction, that with the return of more activity in money and trade there would be again a rush for investment in mining undertakings. The lethargy still hangs over it, and much despondency prevails. Now, Sir, there are causes for this, which ought to be sifted and shown. Such a gloom does not brood over this particular calling because mining is more speculative than other departments of commercial enterprise; it is, in fact, much less so. It was always less so, although formerly more speculative than at present. The acquisitions of science have divested the business of much of its speculative character. It can now be scientifically determined whether ground is ore bearing, and the skill of the mining engineer enables him to proceed upon definite modes of operation, and to prepare an estimate of cost more determinate and accurate than probably is found in any department of works, whether conducted by builders, contractors, shipbuilders, &c. It may occur that the lode lies deeper than was expected, that it turns out poorer than the first yield could justify anyone supposing, that an incursion of water should happen, or some "fault" be discovered; but the mishaps incidental to building such a ship as the Great Eastern or the Warrior, of laying down a line of railway, tunnelling a mountain or under a city, of creating extensive irrigation works, or a ship canal, are far more probable, and of more frequent occurrence. Yet men will invest in such undertakings, and neither be warned or intimidated by loss after loss, while if every mine is not found to be "a lode of wealth" the utmost disappointment is experienced, and the business itself characterised as too risky to be pursued, too uncertain for legitimate investment. If there were rather more hazard to the adventurer, which I deny, there is also more chance of splendid success. Which of all the departments of industry deemed most successful has heaped upon its persevering followers such rich rewards? Great fortunes have been made in cotton spinning and weaving, but wide-spread loss and ruin have again and again swept away the property of the cotton districts.

Shipbuilding has enriched enterprising persons, but how often has the storm scattered the freighted fleets, shattered upon rock and shore? The colonial produce grower, in the cotton field, the indigo, or coffee plantation, &c., has often come home to Leamington or Cheltenham, or Clifton, the victim of disease, and more frequently still are ruined by the failure of crops, or perish by the climate. Now, in mining enterprise at home no such perils exist. The lode fails less frequently than the foreign produce crops. An inundation does not occur so frequently as a shipwreck, the storm that spoils the merchant sweeps over the miner harmlessly; he is, in fact, more free from casualties and the danger of losing the fruit of his capital by disappointment than any other adventurer whatever, and every farmer, every grower of produce, every cattle breeder, merchant, and manufacturer is an adventurer as much as the investor in a mine, without having ground so sure to work upon, or chance so glorious of a magnificent result. It is well known that there are no investments in this or any other country by which such enormous profits have been won by such small expenditure. Well, then, why is mining enterprise now so quiescent, and the interest generally so low? I have no hesitation in saying that the mode in which the business is conducted, and the defects of the law, are the great obstacles, because they render insecure what in its own nature is otherwise. Under the old Cost-book System Cornish mining was very successful. By that process of working every mining property was divided into so many shares, generally among a comparatively few individuals; the state of the property was periodically ascertained and announced, and provision made for the estimated wants of the next period, and so on until the enterprise was profitably brought to an end. There was no uncertainty as to the condition of the property, and no difficulty in closing the enterprise economically and promptly if it ceased to pay. Even now, taking the ten years terminating with 1868, and compare them with any other ten years of half a century, under this good old plan of operation there will be found more mines carried on in Cornwall than has ever been directed by it at any past time. The grand advantage of the system is that by it better than by any other progressive mines are likely to be sustained to a profitable maturity, and not abandoned because some timid or litigious adventurer, as under the Act of 1862, insists upon a winding-up.

The sooner there is a return to the old paths in Cornish and Devon mining the more promptly will the character of the business be redeemed, and enterprise in connection with it prevail. The Companies Act of 1862 has had a very injurious effect upon mining. The formation of a company under the new Act is for mining purposes troublesome, tedious, and cumbersome. Seven persons must be found to sign the Articles of Association, a board of directors must be formed, and all these persons must be remunerated in the form of shares and fees; then there are the legal expenses, and often the legal errors created by the lawyers, and productive of heavier expenses another day. When all is in operation a clique of the most ignorant and irresponsible shareholders may force a winding-up. The company thrown into Court becomes the prey of lawyers and liquidators; there is no getting at its true condition, waste and litigation proceed, and the finale is the destruction of a good property. It is not to be wondered at that such occurrences, which since 1862 have been frightfully numerous, should terrify investors, and injure the reputation of ever so noble and lucrative a branch of industry. It is time that we retrace our steps and return to the old system; and it is also time that the law, as it affects mining property, should be brought into harmony with the interests of the possessors. Having occupied so much of your attention I will now close, but hope, with your permission, to return to a subject so important. THOMAS SPARGO.

Gresham House, London, April 9.

THE PROGRESS OF MINING—AS A SCIENCE, AND SOURCE OF COMMERCIAL WEALTH.

SIR,—In my last I adverted to the general state of depression of the mines of Cardiganshire 30 years ago. It is a singular fact that in a country so famed for the goodness of its mines the whole of them should have fallen into poverty at one and the same time, but such was the case. The only mines producing ore at all were Frongoch, Cwmystwith, and Darren, all the workings in the other great mines had died out. Frongoch, the best mine in the county then, as now, yielded 16 tons of lead ore per month. This is one of the Lisbourne mines, known in the old books as Trawscoed, or Cropwood, the seat of the Earls of Lisbourne. The other Lisbourne mines, such as Logylas, Glogfach, and Glogfawr, were idle. A very great effort to restore Logylas Mine had been made by a Derbyshire miner, Mr. Sheldon. A cross adit had been driven into the hill a distance of 364 fathoms, cutting the lode 60 fathoms deep at right angles, more or less, to its line. Mr. Sheldon stopped short 7 fathoms of reaching the lode, mistaking a lode underlying to the north for the right one, which underlies southward. It is said there that Mr. Sheldon was cheated as to the length of admeasurement of the level: the end was always full of smoke and bad air, so that the agent could with difficulty reach the forebreast, and the man carrying the line used to turn round and wind it about himself. Such tales are current in all countries, but I suspect the truth is there was some hitch as to the dialling. However that may be, Capt. Harris, for Messrs. Williams and Co., of Scorrier, drove up the adit the remaining 7 fms., and cut a good course of ore. This was 40 years ago; 10 years afterwards this course of ore was said to be worked out, and, in fact, a general impression prevailed that the Cardiganshire bodies of ore barely reached down to the basis of the hills, and that it was profitless to attempt to follow them further. But the working of this mine was almost rendered impracticable by the placing of a railway in one of the most splendid dry levels of Cardiganshire, a level 7 ft. high, 4 ft. wide, and perfectly straight for nearly 400 fms. in length. Placing the railway in this level was a piece of engineering so absurd that it seems almost impossible to imagine it could have been perpetrated; but there it was, on wooden horses 3 to 4 ft. high, so that there was barely room for the wagon to pass between the railway and the roof. The first step that was taken to recover the mine was to place the railroad on the ground, or floor of the level, when the removal of the ore stuff, &c., became easy and practicable. The levels were continued on the lode eastward towards Hafod, and a body of ore was found that for 60 fathoms yielded on an average 4 tons, or 50*l.* worth, of ore to the fathom, a discovery that soon exploded the prejudice and fallacy as to the ore ground not holding down.

Just before this discovery the mining population of Cardiganshire were in a very abject state; the hovels were unfit for human beings to live in, the miners were only settled with once in three months, and existence was only sustained on the most meagre of fare, and the farming population lived just as hard as the miners—oatmeal and potatoes constituted the principal food of both. Notwithstanding this, the inhabitants of these mountainous districts were exceedingly healthy and hardy, and capable of performing a great amount of work both underground and at surface. Neither was Cardiganshire well off in its other sources of income. The principal flow of money into the county was through Aberystwith, where the tourists bought about 60,000*l.* per annum. Fishing was the great inducement to the tourists, the rivers being filled with trout and salmon. Unfortunately, these streams, the Rheidol and the Ystwyth, have been greatly contaminated by the mine waters, and this source of profit and amusement has been all but destroyed; but in return a steady trade in mining has grown up that carries to Aberystwith an annual income of fully 200,000*l.*, a business that goes on in summer and winter with little intermission. Notwithstanding this great source of prosperity, now apparently firmly established, it is not uncommon to hear complaints loud and deep in Cardiganshire against the miners for destroying the angling in the river; but if the population were thrown back to the state they were in 30 years ago, when about 400*l.* per month would pay for all the mining labour in the county, and for eight months in the year the inhabitants of Aberystwith seldom got a sixpence from the tourist, it would soon show the comparative merits of mining and angling for trout. I was at first, however, somewhat surprised upon finding the miners coming out of the levels in full working day-dress, walking-stick in hand, watch-chain and hat, small-clothes and stockings, like women going to take a long journey; but I found the cause to be in their having their chests at the inner end of the levels, and that they changed underground, though it seemed a curious difference to me, coming from Cornwall, where one is only accustomed to see the miner go underground in flannel clothes, hat-caps, and full mining costume. There seemed to me something exceedingly ludicrous in meeting a man underground in the same dress that you would meet him in the high road going to market or fair; but that state of things is now done away with, and regularly heated changing-houses are found in most of the great mines, the same as in Cornwall and other countries. Thirty years ago, in Cardiganshire, all mining appliances were on the most contracted and cramped scale: the rollers for crushing the ore were only 15 inches diameter, now they are generally 30 inches; the jigging-sieves were generally in a tube of 3 feet diameter, now the hutch is 12 feet long and 4 feet wide; the old flat buddle was 6 ft. long by 3 ft. wide, now it is 11 or 12 ft. by 7 ft. But the great progress achieved in Cardiganshire mining has

been by making discoveries in following the lines of the lodes from the old workings, of which we will take some further notice in another paper. M. F.

MINE MACHINERY, AND MACHINE MINING.

SIR,—As the time is generally considered to have arrived when copper and tin mining will resume its accustomed activity, it would probably be well to ascertain whether, by the adoption of well arranged machinery, the recurrence of such depression in this very important branch of business could not be altogether prevented. In fact, I agree very much with the opinions of Mr. William Bond, of Illogan, who says:—

"Let there be economy in every direction, extensively introduce scientific processes of development, adopt the contract system, as far as practicable, in all departments, and in all suitable ways earnestly explore our mines, and then—without at all increasing what may be termed establishment costs or charges—no one need hesitate to predict that the result to the adventurers, &c., will be equivalent to the benefits conferred upon them when they obtained former high prices for tin and copper. Carrying out the improvements herein contemplated, with a better price for mineral, which will, doubtless, soon be realised, mining will be placed in a position at once stable, business-like, and remunerative, unknown even in former days of sunshine, and we shall all have reason to be thankful for the lessons of prudence taught in the school of adversity and depression."

Of course, at present the boring of shafts by machinery—that is, the use in mining operations of machine tools of sufficient size to make a 12-ft. shaft—can scarcely be hoped for, but I believe that enormous economy would result from putting down (say) a 2-foot bore-hole by machinery (and this could now be readily done by apparatus such as is constantly advertised in the *Mining Journal* by Messrs. Mather and Platt), and then enlarging the shaft to the required size. Or there is another arrangement which would, perhaps, be even more efficient and much cheaper. Suppose a shaft, 100 fms. deep, has to be sunk, I would put down a 6 or 8-in. bore-hole about a fathom from it, and pump the water from this hole by means of an American sub. merged pump (a plunger pump having the plunger raised by the tubular rod, through which the water passes), which could be worked by a steam-engine of comparatively small size. By putting through a small hole (say) a 3-foot one every half-dozen fathoms, the working shaft could readily be kept free from water, and by stopping the upper holes when lower ones are made a good current of ventilation would be kept up. It will at once be seen that by this means the working shaft need have no pumps in it, so that the time usually wasted in pulling up and replacing the pumps for each blast would be saved, and this, of itself, would be very important. But it may be said that the cost of the bore-hole would be an extra expense. Not at all. If we want a shaft 4 feet by 12 feet rectangular we should get it at less cost, and in half the time. The bore-hole would be put down at the extreme corner of the place chosen for the intended shaft, and the men would be set to sink at the other end. When a depth of 10 fms. has been reached, another pare of men would be put on from surface, and their task would be to enlarge the shaft to its proper size. From the time of putting on the second pare there would always be one pare working 10 fms. below the other, and the shaft could always be properly cased and divided to within 15 fms. of the bottom pare (I believe both time and cost would be saved by not casing and dividing closer than this), whose progress, owing to good air and absence of water, would be at least twice as great as at present. If the pumps were put in at the bore-hole end of the shaft the lower pare of men would not be in any way interferred with, whilst a good stull at every 5 fms. would save them from all danger from falls caused by the working of the upper pare.

As to working mines after the shafts are down, Mr. Bond's views are not so much in accord with my own, although I agree with him that a combination of steam-power and hydraulic apparatus in working our mines is a matter worth the earnest practical attention and consideration of those interested in mining, more especially after the remarks made at the Miners' Association of Cornwall and Devon:—

"Let it be required to develope a piece of ground between two shafts sunk 100 fms. apart; the time necessary by the usual method would occupy 27 months, but with the aid of hydraulic apparatus the same work could be accomplished in 12 months. In other words, 10 fms. of ground 100 fms. long would be ready for overhand stoping in less than one-half the time. Again, to cite one or two actual cases, both in respect of time and money. The estimated cost of developing a piece of ground in the ordinary way was 1777*l*. 10s., and the time necessary was 63 months; but by the application of hydraulic machinery the expenditure was limited to 1212*l*. 10s., and the time to 24 months. In the second instance, the estimated cost for erecting steam machinery and sinking a shaft to reach an isolated deposit of ore was 1295*l*., and the time required was 18 months; but the same result was obtained for an expenditure of 310*l*., and the work accomplished in four months."

Now, in the 14 months thus saved there would be no necessity to pay directors, committeemen, agents, pursers, and many others who now swallow up such a large proportion of the profits, so that an increase of 10 per cent. in the wages of the workmen could be paid, without making any undue charge upon the adventurers.

Now, whether a machine simply useful for drilling a hole (like Doering's) or one which makes the level at once (like Penrice's or Beaumont's) be employed, the great difficulty must always be the keeping of the machine in repair, and the supplying it with motive-power. Capt. Teague states that at the Tincroft Mine the 184 fm. level is being driven by Doering's boring-machine, which he considers to be a decided success, and will be found of great service in opening their levels. They have some very valuable pieces of ore ground opening about the 200 fm. level, and the 222 is now worth about 50*l*. per fathom. Now, in driving in rich ground like this, of course Doering's or any other machine might prove available, but from what I have seen of the machines themselves I do not believe that any of those introduced at present will prove more than a very temporary success. The machine of General Haupt, when it was tried at an engineers near Oxford-street, London, was worked under the most favourable conditions, within 6 ft. of the boiler, which supplied it with steam at 60 lbs. pressure on the square inch, yet did not bore at the rate of ¼ in. an hour, and seldom worked five minutes together without requiring re-arrangement. As to Doering's, the sample machine, which has doubtless been constructed with more than ordinary care, has certainly worked a few weeks without requiring repairs, but so many, to say the least, erroneous statements have been made concerning the machine by those advocating its use that it is evident they have no confidence in its real merits. At Tincroft the rate of boring was stated to be about 1 inch a minute in a hard granite rock, interspersed with tin capel (hard chlorite, tin, and quartz), and, therefore, the rate of driving the end was double that of former driving by men without the aid of the machine; and it is said that the machine acted as a ventilator for the end also, and that the amount of smiths' cost by the machine would be very much less than by hand labour; but this saving, as pointed out by the assistant engineer, arises from the fact of his borers being properly heated by the smith, when one borer will bore as much, perhaps, as three or four when the steel is overheated by the mine smith, that he may do his work with less trouble. A great quantity of steel is destroyed every year by the mine smiths, as well as the work of the miners interrupted. There was another statement made by the engineer—that there is little or no friction in the passage of the compressed air through the pipes, so that the power may as well be generated 500 fms. from the end as 500 in., and the loss of air while the machine was stopping was imperceptible by the indicator.

That a machine worked by compressed air would ventilate the close end in which it is placed cannot be questioned, and that the miner's labour is often much increased through the smith working the borer-steel too hot, is equally true; but that air will pass through pipes, with little or no friction, is absolutely false, as mine adventurers will find to their cost, if they act upon any such assumption. A hand drilling-machine (such as Abegg's) is the only one likely to prove permanently useful, and the advantage of even that is somewhat questionable. B. J. D.

MINING—AS A SPECULATION AND INVESTMENT.

SIR,—I am a man of business, and a man of the world; but of mining, as a scientific pursuit, I am profoundly ignorant. I was never down a mine in my life—I doubt whether I could tell tin from copper ore—and I am certainly quite unable to understand the technical phrases by which your correspondents are accustomed to explain the progress of their enterprises. Even as an investor in mines my experience is very recent and very limited; but still, such as it is, it has suggested to me certain conclusions, upon which I shall be glad to hear the opinions of more capable speculators. I will begin by freely admitting that I am inclined to place a considerable degree of faith in the eulogies which mining agents are accustomed to bestow upon their favourite industry. I really believe that well-selected mining investments are the most profitable in which a small capitalist can lay out his money. The dupe who is induced by his plausible friend to risk his whole fortune in an unopened mine is, of course, a myth, and, if he existed, would be a madman; but the man who sets apart a certain portion of his capital for mining speculations, and carefully spreads his investments under the advice of an experienced broker, is, in my opinion, likely to get a larger and surer profit than he could secure by any other means. There are, however, several different principles upon which a capitalist may select his mining investments. I have tried them all, or nearly all, and I must admit that I have no reason to complain of any; but still the impression left upon my mind certainly is that the form of mining speculation which to an outsider appears the most hazardous is, in reality, by far the safest and the most profitable.

1.—I most decidedly prefer progressive to dividend-paying mines. There are, of course, some striking exceptions; but I think that, as a general rule, the market value of successful mines is unduly high in proportion to their profits. Considering that the richest mine must in a comparatively short time become exhausted, I am quite at a loss to understand how prudent investors can think any mining income worth ten or twelve years' purchase, and I am still more puzzled by the undoubted fact that the longer a given mine pays handsome dividends the more confident purchasers seem to become that it will never cease to do so.

2.—In selecting progressive mines I usually prefer speculative to permanent investments. I do not, of course, mean to recommend speculation in what are termed market mines. I should think it neither prudent nor honourable to buy worthless shares in the expectation that they will be puffed into notoriety; but I think it a perfectly fair speculation to buy shares in a really valuable property, which the credulity or ignorance of the market has made cheap, in the confident expectation that they will sooner or later recover their proper price, and this is the sort of mining investment which, as a general rule, I prefer.

My reason for this preference is easily explained. I think it much easier to calculate the apparent than the actual value of a mine. When an experienced adviser tells me that a particular mine is sure to pay dividends next year, I believe that he is probably right, but I know that he may easily be wrong; but when he tells me that a particular mine, looking at its visible chance of success, is at the present moment worth twice or thrice its market price, I know that he can scarcely be mistaken, and I also know that if he is right the public can scarcely fail to discover the truth in a short time.

Let us now suppose an imaginary case. I have by me (let us say) 400*l*. to invest in mines. I begin by perusing the list of mines, and by making a note of those whose market price is less than one-half or one-third their paid-up expenditure. I then ascertain, from the mining agents' circulars, which of these mines are thought by experienced judges to be unreasonably cheap. I get all the information I can about the mines thus recommended, and I finish by selecting (suppose) four, in each of which I invest about 100*l*.

Next, let us consider the sort of result which I may fairly expect. In six months two of my mines have recovered to par—that is to say, the shares are worth double what I gave for them; a third is about stationary; and the fourth has proved worthless and unsaleable. Proceeding to realise, I get 200*l*. for each of my two first investments, 100*l*. for my third, and nothing at all for my fourth. I, therefore, pocket 500*l*. in all; or, in other words, I make 25 per cent. profit in six months upon 400*l*.

Now, I am quite sure that no experienced mining agent will say that my expectations are too sanguine, or that my imaginary investor has had unusually good luck. That a number of experienced brokers should pronounce four cheap mines well worth the outlay upon them, and that they should be quite wrong as to two, would, in my opinion, be rather a remarkable coincidence the other way. It follows that a capitalist who judiciously selects a certain number of cheap mines may fairly expect, as a general rule, to re-sell in six months at a profit of one-fourth—in other words, that he may expect to make 50 per cent. per annum upon his capital.

Next consider the alternative. I invest my 400*l*. in four highly promising progressive mines, and await the ultimate result. Two of them succeed brilliantly, and pay me from 40 to 50 per cent. as long as I live; a third succeeds respectably, and pays me from 10 to 20 per cent.; the fourth turns out a failure, and pays no dividends at all. The result is that I get altogether about 100*l*. income from my 400*l*., or about 25 per cent. per annum upon my entire outlay; surely no one will deny that I have been very successful—and yet my success has not produced more than half the annual profit which I might have expected if I had judiciously shifted my investments. I will not occupy your space by anticipating the objections which may be made to this mode of laying out money; perhaps, if any of your other correspondents think the question worth taking up, I may hereafter return to its discussion. IGNORAMUS.

WEST ST. IVES MINE.

SIR,—In the present depressed state of the mining interests, when, owing to the long-continued low prices at which metals have ranged, many of the deep and more expensive mines have been unremunerative, it will be cheering to those who are interested in our mineral industry, and especially to the shareholders in the mine itself, to know the favourable prospects of West St. Ives, which, from its position amongst mines that have proved so rich, as well as from its indications, and from the unusual cheapness with which it is worked, is one of the most promising young mineral properties of the present day. This mine is situated close to the junction of the granite and killas in one of the richest and most productive tin districts in Cornwall—in the parish of St. Ives, which, with those of Lelant, Towednack, and Zennor, has been long known as highly productive of tin ores of peculiar richness. This is evidenced by the produce of three of the mines adjacent to West St. Ives, which have yielded the following returns for tin sold by them during the last seven years for which those returns are made up (1860 to 1866), as may be seen in Mr. Robert Hunt's "Mineral Statistics of the United Kingdom" for the respective years:—

	Value of Tin sold.
St. Ives Consols	£110,920
Providence	154,619
Wheal Margeret	69,448
Total	£334,987

The richness of the district is also further proved by the dividends which have been paid in late years by the following mines situated therein:—

St. Ives Consols	£111,531	Balnoon	£ 49,000
Providence	94,760	Wheal Mary	42,000
Wheal Margaret	67,368	Wheal Trenwith	24,000
Wheal Reeth	98,000		
Wheal Kitty	56,000	Total	£542,659

The above dividends were the results of only recent workings of these mines, and are in addition to much larger sums received from sales in former workings, of most of which no record can now be obtained. Fortunately, however, details of the whole profit yielded by the St. Ives Consols are preserved, from which it appears that that mine paid its shareholders, in dividends, a profit of no less than 461,070*l*., on an outlay of only 7520*l*., and it was from this source chiefly that the late Mr. James Halse, M.P. for St. Ives, realised his large fortune. The profit derived from St. Ives Consols has a most important bearing on West St. Ives, as the two properties are in close proximity; the lodes are parallel, and both the lodes and the stratification in which they are embedded present exactly the same characteristics and indications, leading experienced miners confidently to anticipate similar results as certain.

West St. Ives Mine, being situated immediately on the sea-coast, where the cliff rises fully 50 fms. above high-water mark, is worked very easily, and at a trifling cost, by adits driven in from the face of the cliff, and the mine is drained thereby, so that no pumping machinery is required, nor will be for a long time to come, and all the drawing of deads to that depth will be completely saved. The principal workings hitherto have been upon the east and west lode, which produces tin of first-rate quality, as much as ½ cwt. in a stone, making a produce of 72½ per cent., and, as the skip-road for hauling the ore to surface is complete, the mine will now begin to make returns, when its value will be seen and recognised. Shortly after operations were commenced upon the mine Capt. James Pope, late of Wheal Basset, inspected it, and reported upon it as follows:—"The stratum has been greenstone, but, from the appearance, I think it will soon be a beautiful killas, which can be seen in the bottom of the level, when a change may be expected; the ground is much softer, and highly mineralised, also the lode improving in appearance. The depth now from surface I should say is about 30 fms., and in the next 40 fms. driving will be 50 fms., so that a good trial can be made in opening on the lodes without the aid of machinery. I think this piece of ground is worthy of trial—quite unexplored, and bounded on the south by St. Ives Consols and Providence Mines, and on the west by Rosewall Hill and Ransom, which have given large profits for several years; also traversed by cross-courses and greenstone, about which nearly all the mines in this district make rich deposits of mineral—from which, if properly explored, I have every reason to expect a good mine will be found, as a great length can be laid open for a small outlay."

As operations proceeded, the change in the strata which had been anticipated by Capt. Pope occurred, and in the early part of the present year that able and experienced miner was requested to visit and examine the mine again, and the following is his highly favourable report:—

"*Redruth Feb.* 1, 1868.—I find an adit driven from the sea level on the course of the lode in West St. Ives Mine about 30 fms., the lode varying in size from 1 to 2 ft. wide, producing a little tin in several places, the greater part of the drivage being a greenstone; but now in the bottom of the end the lode is very much improved in appearance, and a great change in the strata has taken place, being now a fine mineral bearing killas, from which a better lode may be expected shortly. From what can be seen at the sea level, a cross-course will soon be intersected (say in the next 8 or 10 fms. driving), about which the mines in this district seldom fail to make rich deposits of mineral. Another lode can be seen about 20 fathoms south of the present, which can be intersected by cross-cutting about 20 fathoms south on the cross-course, about which the richest bunches are found; this I consider of some importance, being about 50 fathoms from surface. I have reason to expect a good mine will be laid open without the aid of pumping machinery. Looking at this piece of mining ground and the great change in the strata which has taken place in the last few days, I should think that with a small outlay and economy a good mine will be laid open shortly; and I can recommend it with confidence as a good piece of mining property to any company of gentlemen inclined to adventure in mining.—JAMES POPE."

Since this last inspection by Capt. Pope the improvement in this lode, and the intersection of the cross-course (both of which were expected and foretold by him) have taken place, and another cross-course, yielding copper, has been met with, as will be seen from the following reports by the agents of the mine, and inserted in the columns of the *Mining Journal* at the respective dates:—

"The lode is greatly improved in size since we left the greenstone; it is now from 6 to 7 feet big, producing stones of copper ore and tin.—THOMAS UREN: *Feb.* 12."

"In the level driving west on No. 1 lode we have intersected the cross-course. The lode made rich stones of tin and copper up against it, and we calculate, when we find the lode on the other side of the cross-course to meet with tin.—JAMES EVANS: *Feb.* 20."

"We have got through the cross lode—it is a beautiful lode, about 8 ft. wide. We have not yet cut the east or west lode, as it is heaved by the north and south lode. The killas west of cross-course is more congenial for mineral, and we are now driving in order to cut the east and west lode on the other side of the cross-course.—THOMAS UREN: *March* 7."

"We are still driving on the cross lode, and daily expecting to cut the east and west lode. The cross lode is a beautiful one, and is very green. I think there is a great quantity of copper before us.—THOMAS UREN: *March* 14."

"We have not yet succeeded in cutting the east and west lode, west of cross lode. To-day, in taking down some ground west of the cross lode, we cut another cross lode, but how large it is we cannot say; we have cut through it 2 ft., and it is producing good stones of copper. I fully believe we shall have a good lode west of these beautiful cross lodes as soon as we cut it. Our skip has been in course of working to-day and yesterday, and will continue so throughout the week in pulling up the tin and copper ore, and then we shall stop it a little while until we cut the east and west lode.—THOMAS UREN: *March* 31."

The intersection of the cross-course above described affords a very favourable opportunity for driving to cut the south lode, from which good stones of ore have been broken at surface, and thus both lodes will be explored easily, and at a small expense; and, as the north and south lodes differ somewhat in their longitudinal bearing, they must form a junction a little further west, at which point, according to analogy and experience, they will both be enriched. There are other parallel lodes, which have not yet been opened on, but which can be worked from the said adit level, and, looking at the proved richness of the district in which the mine is situated, at the indications and evidences it already gives of mineral wealth, at the very trifling cost at which it is being worked, and at the great profits derived from neighbouring mines, as shown above, there is every ground of confidence that this mine, when a little more opened, will become a highly remunerative one to the shareholders, and will afford a maintenance to many of the industrious and deserving of the mining population, who have been suffering grievous privation and want from the deficiency of employment in Cornwall during the last two years. With such prospects are those described above, it would hardly be credited that the shares in West St. Ives Mine are now obtainable at a few shillings each, being but little over 2000*l*. for the whole property, a price so low, in comparison with those of many other mines of far less merit, that it could never have existed if the real prospects and capabilities of the sett were generally known, especially with the decided upward tendency in the price of tin.

It should be particularly noticed that West St. Ives Mine is totally different and in no way connected with the West St. Ives Consols Tin Mining Company (Limited)—this latter being a resuscitation of a company which was formed to work a grant in the parish of Towednack, and was discontinued about four years ago for want of further capital, but which, nevertheless, ought to have the best wishes of all friends to mining.

A SHAREHOLDER IN WEST ST. IVES.

THE DARIEN CANAL—No. XVI.

SIR,—Not only would all the commerce of the western shores of North and South America pass through the Canal, but after its opening no voyages could be made round the Cape of Good Hope to China and Australia, as they would be much more accessible by the Darien Canal than by the present circuitous route, and the voyage could be made within one tropic, whilst at present a vessel must pass four times through each tropic in a single voyage out and home. As regards passages to and from the West Coast of America, it is sufficient to say that to sail, for instance, from Aspinwall to Panama, a distance of 46 miles by land, it would be necessary to sail from 9° N. to 55° S. latitude, in order to weather the stormy Cape Horn, and to return up the West Coast to 9° N. on the Pacific side. The ship would have to sail over 64° of latitude on each ocean, or 7680 nautical, equal to 8896 English miles, on a single passage, or 17,792 miles on a voyage to and from. Besides this enormous distance in latitude to be traversed, it must also be taken into account that the vessel would have to run off to the eastward as far as 30° W., in order to avoid the coast of Brazil, and to make back the same distance to the westward. She would also be obliged to beat to windward both in the Atlantic and Pacific; against the S.E. trade wind in the former when bound from Aspinwall to Panama, and the latter when bound from Panama to Aspinwall. Moreover, the terrific storms from the W. often experienced off Cape Horn, might delay her entrance into the Pacific for weeks. Vessels bound to and from China and Australia would by the Darien route have such fair, steady, regular winds, that their arrival might be calculated upon with precision and accuracy. In a passage to China by the Canal a vessel, having cleared its Pacific terminus, would at once enter into the track of the N.E. trade wind, which blows between the parallels of 10° and 25° N., and, her course being W., she would be carried with a fair and steady breeze directly to her destination. On the return voyage from China to the Canal a ship would at once run up to between 30° and 40° N., so as to be clear of the region of the N.E. trade wind, and avail herself of the strong W. winds that prevail between those parallels to steer an E. course to the coast of Mexico. There she should meet the N. land wind, which would carry her with a flowing sheet down to the Isthmus.

On a passage out to Australia a ship would, after leaving the Canal, enter a narrow tract extending from 10° to 4° N., in which the winds are variable. Having crossed this, she would enter the region of the S.E. wind, which would be perfectly fair, her course being W.S.W. Having passed the southern limit of this wind in 23° S. latitude, she would enter the region of the N.W. wind, which also be favourable to her course. On her return from Australia she might at once run up into the S.E. trade wind in latitude 23° S., from whence, her course being E.N.E., she would have a fair wind all the way; or she might run down part of her easting within the limits of the N.W. wind, and then run up into the S.E. trade wind, by doing which she would have the wind a couple of points more free.

The vast saving of time that will ensue from the adoption of this passage, which will enable ships to make two or three voyages in the same period that they now take to make one, the saving of expense in their navigation, of wear and tear, of interest on the value of ship and cargo; of insurance of ship, cargo, and freight; and the great diminution of shipwrecks and loss of life by sea, will effect a complete but beneficial revolution in commerce. Not only will a great saving of time be effected by the direct diminution of distance to be traversed between Europe and the East Coast of America on the one side, and the West Coast of America, China, Japan, Australia, &c., on the other, and *vice versa*, but also by the avoidance of the loss of time occasioned by calms in the low latitudes, hard gales off the Capes, and the very long tacks to the eastward and westward which vessels are now obliged to make in beating against the S.E. trade wind in the South Atlantic, or the N.E. or S.W. monsoon in the China Seas. By the proposed Canal all those causes of delay will be obviated, and fair, steady winds, smooth seas, and pleasant weather throughout the voyage, both out and home, may be fairly calculated upon. Nor are the benefits resulting from increased intercourse and proximity the only advantages which may be hoped for. The safety of life and property will be greatly increased, the hardships of thousands of mariners will be lessened to an incalculable extent, and the facilities for benefiting our fellow-creatures will be greatly multiplied. The gold discoveries in California and Australia have imparted an impulse to ocean navigation, to the results of which it is impossible to assign any limits; nor until the Darien Canal is completed can we estimate the effect it will have in diverting the commerce between the east and west hemispheres from the old routes. That by Cape Horn will be totally abandoned, and that by the Cape of Good Hope will be preferred only by vessels bound to the hither side of the Straits of Malacca. To all countries lying further east—to China, Japan, Australia, New Zealand, &c.—the most comfortable, safe, speedy, and least expensive route will be through the Isthmus of Darien Ship Canal. E. CULLEN.

PAPERS ON PRACTICAL MINING.—The thoroughly practical character of the papers read at the recent meeting of the Miners' Association of Cornwall and Devonshire will render the detailed report of the meeting particularly acceptable to all engaged in mining operations.

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The price of the book is 1s., and it will be forwarded from the *Mining Journal* office on receipt of 13 stamps.

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